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Association of Mediterranean diet and other health behaviours with barriers to healthy eating and perceived health among British adults of retirement age

Jose Lara*, Leigh-Ann McCrum, John C. Mathers

Human Nutrition Research Centre, Institute for Ageing and Health, Newcastle University, Biomedical Research Building, Campus for Ageing and Vitality, Newcastle upon Tyne NE4 5PL, UK

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ABSTRACT

Objectives: Health behaviours including diet, smoking, alcohol consumption, and physical activity, predict health risks at the population level. We explored health behaviours, barriers to healthy eating and self-rated health among individuals of retirement age.

Study design 82 men and 124 women participated in an observational, cross-sectional online survey.

Main outcome measures A 14-item Mediterranean diet score (MDPS), perceived barriers to healthy eating (PBHE), self-reported smoking, physical activity habits, and current and prior perceived health status (PHS) were assessed. A health behaviours score (HBS) including smoking, physical activity, body mass index (BMI) and MDPS was created to evaluate associations with PHS. Two-step cluster analysis identified natural groups based on PBHE. Analysis of variance was used to evaluate between group comparisons.

Results: PBHE number was associated with BMI ($r = 0.28$, $P < 0.001$), age ($r = -0.19$; $P = 0.006$), and MDPS ($r = -0.31$; $P < 0.001$). PHBE cluster analysis produced three clusters. Cluster-1 members (busy lifestyle) were significantly younger (57 years), more overweight (28 kg/m^2), scored lower on MDPS (4.7) and reported more PBHE (7). Cluster-3 members (no characteristic PBHE) were leaner (25 kg/m^2), reported the lowest number of PBHE (2), and scored higher on HBS (2.7) and MDPS (6.2). Those in PHS categories, bad/fair, good, and very good, reported mean HBS of 2.0, 2.4 and 3.0, respectively ($P < 0.001$). Compared with the previous year, no significant associations between PHS and HBS were observed.

Conclusions: PBHE clusters were associated with BMI, MDPS and PHS and could be a useful tool to tailor interventions for those of peri-retirement age.

1. Introduction

There is strong evidence that lifestyle behaviours including poor diet, smoking, low physical activity, high alcohol consumption, or high body mass index (BMI), are strongly associated with health [1]. Together, these behaviours are associated with four-fold increases in total mortality in men and women [2,3] and make a substantial contribution to the global burden of disability [4]. In addition, self-rated health, an independent predictor of mortality, [5] is associated with health behaviours [6].

In an era when the world's population is ageing and the retirement age is being extended in many countries, developing effective lifestyle-based interventions, including dietary interventions, offers considerable potential to promote healthy ageing [7,8]. Interventions targeting people of retirement age may be particularly useful since this life-transition is associated with other behavioural changes [9,10], and improved eating habits may alter the ageing-trajectory and reduce the burden of age-related disability and disease. The health benefits of consuming a Mediterranean diet (MD) have been demonstrated in numerous epidemiological studies [11–13]; and these observational findings are now supported by evidence from primary [14,15], and secondary prevention randomised clinical trials [16]. However, interventions promoting the MD outside Mediterranean countries are scarce [17–19] and current evidence suggests that most dietary interventions result in only small to moderate effect-size [20].

Identifying and addressing perceived barriers to healthy eating (PBHE) is a critical step in developing effective dietary interventions. There are no studies of PBHE in people of retirement age but a European survey of young and middle-age adults reported that

* Corresponding author. Tel.: +44 0 1912481141.
E-mail addresses: jose.lara@ncl.a.uk, jjlaragallegos@yahoo.com (J. Lara).

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"concerns with time" and "taste" were the most frequently reported PBHE [21]. In addition, a small study on 39 older men (mean age 75 years) identified "poor cooking skills" and "low motivation to change eating habits", as important PBHE [22].

The aims of the present study were to evaluate the association between PBHE and adherence to the MD and the associations of health behaviours with perceived health based on responses to a cross-sectional online-survey among older UK adults.

2. Methods

This study was approved by the Human Psychology Ethics-Committee at Newcastle University (Registration no. 000436) and conforms to the principles embodied in the Declaration of Helsinki. Participants provided consent via an e-form.

2.1. Study design

Observational, cross-sectional online-survey of dietary habits, PBHE and perceived health. This paper is reported following the STROBE statement [23].

2.2. Sample

We recruited 82 men and 124 women, aged ≥50 years, from among the general public. By design, participants of this study had to have regular access to internet and email and, apart from age, no other inclusion/exclusion criteria were employed. Recruitment was supported by Voice North, the community engagement panel at Newcastle University (http://www.ncl.ac.uk/changingage/engagement/voicenorth/), and the University of the Third Age (http://www.u3a.org.uk/). The study was also advertised among staff at Newcastle University, Queens University Belfast and University of Ulster. A "snowball" sampling procedure was attempted by asking participants to forward the invitation to join the study to others. Although participants of this study were a convenience sample, we recruited a wide range of individuals in terms of education, physical activity levels, marital and socioeconomic status and sex.

2.3. E-survey

The survey was developed using Newcastle University Information Systems and Services' Form Builder resource for the creation of web forms. Participants volunteering to take part in this survey received the uniform resource locator (URL) for the survey by Pilot testing of the survey materials for clarity, understanding and time taken to complete the survey was undertaken prior to the current survey.

2.4. Measures

The e-survey included the following questionnaires:

(1) A questionnaire requesting information on demographic and lifestyle factors and self-rated health status. Participants self-reported their smoking habits and self-rated their physical activity in a five-point Likert scale from "very low" to "very high". BMI was estimated from self-reported weight and height. Participants self-rated their current perceived health status (PHS) using a five-point Likert scale from "very bad" to "very good", and reported perceived changes in their health during the year preceding the survey.

(2) MD adherence was assessed using the 14-item PREDIMED score (MDPS) [24]. The range of possible scores for MDPS is 0–14 with higher scores indicating greater MD adherence.

(3) A questionnaire asking participants to identify PBHE from a previously published list derived from a pan-EU consumer attitudinal survey [21].

2.5. Statistical analysis

A health behaviours score (HBS) including tobacco smoking, self-rated physical activity level, BMI and the MDPS was created to evaluate associations between health behaviours and self-rated health. Participants were assigned one-point for each variable based on the following four criteria: BMI < 25; currently being a non-smoker; having moderate/high physical activity status; and being in the top MDPS-tertile (i.e. MDPS ≥ 7). Values for this score ranged from 0 to 4, with higher values indicating the presence of more healthy behaviours.

Two-step cluster-analysis was used to identify natural groups of PBHE. Step one involved creation of pre-clusters from cases by constructing an algorithm known as the Cluster feature tree. In Step two, pre-clusters were merged using agglomerative hierarchical clustering. Cluster-membership and the optimal number of clusters were determined using model fit indices including log-likelihood distance measure and the Schwarz's Bayesian information criterion.

PBHE cluster-membership was used as a categorical variable when investigating links with lifestyle behaviours including MD adherence using the General Linear Model. Results were adjusted for covariates including age, sex, and BMI. Adjusted results were reported as the Least Squares Means (LSM) and standard errors (SE). Spearman' and Pearson's correlation coefficients were used to assess associations between variables. Partial correlation was used to adjust for additional variables. Categorical variables were compared using the chi-square test. Statistical analyses were carried out with IBM SPSS v19 for Windows.

3. Results

3.1. Participant characteristics

Participants in this survey were on average 61 (SD 7) years of age with males being 2.3 years older than females ($P = 0.03$). The sample had a sex ratio of 2:3 of male to female respectively. On average participants were overweight (BMI $26 \pm 4\,kg/m^2$), with no significant difference in mean BMI between men and women. A significantly ($P = 0.01$) higher proportion of males reported that they were retired from work and men were more likely ($P = 0.02$) to be educated to degree level or above (Table 1). Most participants (95%) were not current tobacco smokers and over 70% reported being moderate alcohol consumers.

3.2. Mediterranean diet adherence

Overall mean MDPS was 5.6 ± 2; participants in the top tertile (31% of sample) scored ≥7, and only 6% of participants scored ≥10. After adjustment for age and BMI, women ($n = 124$) scored significantly ($P = 0.016$) higher than men ($n = 82$) (Table 2). There was an inverse statistically significant association between MDPS and BMI (Fig. 1). Age- and sex-adjusted comparisons showed that participants scoring ≥9 in the MDPS were significantly ($P = 0.004$) leaner (LSM ± SE BMI 23.8 ± 0.926) than those scoring ≤8 (LSM ± SE BMI 26.7 ± 0.294).

Table 1
Characteristics of participants.

	Men ($n=82$)	Women ($n=124$)	
	Mean ± SD	Mean ± SD	P^a
Age (years)	62.2 ± 7.5	59.9 ± 7.1	0.029
Body mass index (kg/m^2)	26.9 ± 3.9	26.0 ± 7.1	0.122
	N (%)	*N* (%)	P^b
Place of birth			
UK born	77 (93.9)	110 (88.7)	0.21
Non-UK born	5 (6.1)	14 (11.3)	
Education			
Below degree	35 (42.5)	73 (58.9)	0.02
Degree and above	47 (57.3)	51 (41.1)	
Marital status			
Married	63 (76.8)	82 (66.1)	0.10
Not married	19 (23.2)	42 (33.9)	
Retirement status			
Retired	52 (63.4)	54 (43.5)	0.01
Not retired	30 (36.6)	70 (56.5)	
Smoking status			
Current smoker	6 (7.3)	4 (3.2)	0.18
Non-smoker	76 (92.7)	120 (96.8)	
Drinking habits			
Drinks alcohol	75 (91.5)	108 (87.1)	0.33
Does not drink alcohol	7 (8.5)	16 (12.9)	
Health status			
No medical problems	37 (48.8)	71 (59.7)	0.12
Medical problems (Hypertension, High-cholesterol, Cardiovascular disease, Type-2 diabetes, Other)	45 (52.2)	53 (40.3)	

P^a *P*-value for independent student *t*-tests; P^b *P*-value for chi-square tests.

Participants reported the greatest adherence to the following components of the MDPS: "preferentially consume chicken, turkey, or rabbit meat" (81.1%), "≥2/day servings of vegetables" (78.2%), and "<1/day servings of sweet or carbonated beverages" (70%). The MDPS components with the lowest adherence were: "≥4 tbs/day olive oil" (6%), "<1 serving/day of red meat, hamburger, or meat products" (7.8%), "≥7/week glasses of wine" (12.1%), "≥3/week servings of fish or shellfish" (16.5%), and "<1/day servings/day of butter, margarine, or cream" (18.4%). Results for men and women separately are provided in Table 2.

Table 2
Adherence to the individual components of the Mediterranean diet assessed using the PREDIMED score (MDPS).

	Men ($n=82$)	Women ($n=124$)
	LSM ± SE	LSM ± SE
PREDIMED score (MDPS)	5.2 ± 0.219	5.9 ± 0.178
	%	%
(1) Used olive oil as main fat for cooking (Yes/No)	51.2	62.1
(2) ≥4 tablespoons of olive oil a day	7.3	4.8
(3) ≥2 servings of vegetables a day	70.7	83.1
(4) ≥3 servings of fruit a day	35.4	53.2
(5) <1/week servings of red meat, hamburger, or meat products	4.9	9.7
(6) <1/day servings of butter, margarine, or cream	15.9	20.2
(7) <1/day servings of sweet or carbonated beverages	72.0	68.5
(8) ≥7/week glasses of wine	15.9	9.7
(9) ≥3/week servings of legumes/pulses	51.2	47.6
(10) ≥3/week servings of fish or shellfish	13.4	18.5
(11) <3/week servings of commercial sweets or pastries	39.0	43.5
(12) ≥3/week servings of nuts	23.2	18.5
(13) Preferentially consume chicken turkey or rabbit meat instead of veal, hamburger or sausage (Yes/No)	70.7	87.9
(14) ≥2/week consume vegetables, pasta, rice, or other dishes seasoned with tomato based sauce	40.2	54.0

PREDIMED score (MDPS) comparison between men and women (adjusted for BMI and age) ($P=0.016$).

3.3. Health behaviours score (HBS)

Overall, 39.9% of participants scored 1 point in the HBS by reporting a BMI <25 kg/m^2, 96.6% scored 1 point for not smoking, 32.5% scored 1 point for scoring ≥7 in the MDPS, and 72.9% scored 1 point for being moderate-to-highly physically active. The mean HBS for all participants was 2.57 ± 0.97 with significantly higher age- and BMI adjusted mean scores for females (LSM ± SE 2.52 ± 0.071) than for males (LSM ± SE 2.18 ± 0.087; $P=0.004$).

3.4. Perceived barriers to healthy eating (PBHE)

Study participants reported a mean of 4 ± 2 (range 1–11) PBHE. The number of PBHE was positively associated with BMI ($r=0.28$;

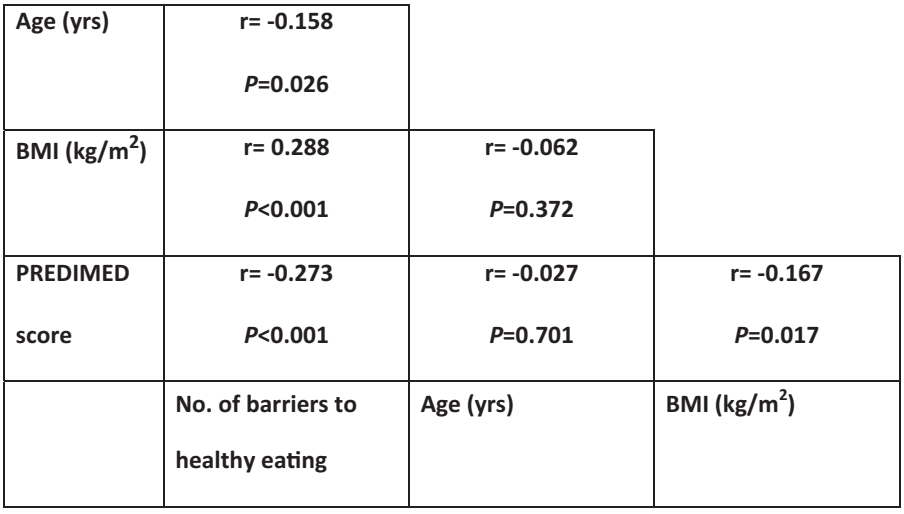

Fig. 1. Pearson correlation analysis.

Table 3
Characteristics of PBHE clusters.

	Non-adjusted least squares means ± SE			P	Adjusted least squares means ± SE			P
	Cluster 1 (n = 42)	Cluster 2 (n = 93)	Cluster 3 (n = 65)		Cluster 1 (n = 42)	Cluster 2 (n = 93)	Cluster 3 (n = 65)	
Age (years)	57.2 ± 1.1	61.6 ± 0.7	61.7 ± 0.9	0.001	57.2 ± 1.06	61.5 ± 0.71	61.8 ± 0.86	0.001[a]
BMI (kg/m^2)	28.0 ± 0.62	26.4 ± 0.42	25.5 ± 0.50	0.007	28.0 ± 0.64	26.4 ± 0.42	25.5 ± 0.50	0.010[b]
PREDIMED score (MDPS)	4.71 ± 0.30	5.61 ± 0.20	6.20 ± 0.24	0.001	4.8 ± 0.31	5.6 ± 0.20	6.1 ± 0.24	0.005[c]
No. of perceived barriers to healthy eating (PBHE)	6.9 ± 0.24	3.5 ± 0.16	1.9 ± 0.19	<0.001	6.8 ± 0.25	3.4 ± 0.16	2.0 ± 0.19	<0.001[c]
Health Behaviours Score (HBS)	2.07 ± 0.15	2.27 ± 0.01	2.74 ± 0.12	0.001	2.34 ± 0.13	2.26 ± 0.08	2.58 ± 0.01	0.049[c]

[a] *P*-values adjusted for sex.
[b] *P*-values adjusted for age and sex.
[c] *P*-values adjusted for age, BMI, and sex.

$P < 0.001$), and inversely associated with age ($r = -0.19$; $P = 0.006$) and MDPS ($r = -0.308$; $P < 0.001$) (Fig. 1). After controlling for age and BMI, a significant negative association between PBHE and MDPS remained ($r = -0.237$; $P = 0.001$). Spearman's correlation coefficient showed a moderate inverse correlation between number of PBHE and HBS ($r = -0.397$; $P < 0.001$).

3.5. PBHE classification and cluster characteristics

Two-step cluster analysis produced three discrete clusters of participants based on their reports of PBHE. Cluster-1 ($n = 42$) was characterised by PBHE such as "busy lifestyle", "irregular working hours", or "the belief that healthy eating involves lengthy preparation". The important PBHE for participants in cluster-2 (93) included "lack of willpower" and "finding it hard to give-up liked foods". Finally, participants in cluster-3 ($n = 65$) reported few PBHE.

On average, members of cluster-1 were younger (mean 57 years), more overweight (mean BMI = 28), and reported the lowest MDPS (mean = 4.7). In addition they identified the largest number of PBHE (mean = 7), and reported the lowest HBS (mean = 2.34). In contrast, members of cluster-2 were older, leaner, reported a lower number of PBHE, and scored higher in MDPS and HBS. Finally, members of cluster-3 were the leanest (BMI = 25.5 kg/m^2), scored highest on MDPS (mean = 6.2) and reported the lowest number of PBHE (mean = 2) and the highest HBS (mean = 2.58). These unadjusted findings remained statistically significant after adjusting for age, sex and BMI. (Table 3) Pairwise comparisons indicated that cluster-1 was significantly different from clusters-2 and -3 in terms of BMI, MDPS, and number of PBHE but only cluster-2 and cluster-3 differed significantly in HBS.

3.6. Health behaviours score (HBS) and perceived health status (PHS)

PHS ratings were merged into three classes bad/fair ($n = 26$), good ($n = 102$) and very good ($n = 78$). Sex- and age-adjusted comparisons between these PHS groups showed significant differences in terms of BMI (LSM 29.0, 26.8, 25.0 kg/m^2 respectively; SE = 0.443; $P < 0.001$), MDPS (LSM 5.7, 5.3, 6.1 respectively; SE = 0.191; $P = 0.032$) but sex-adjusted ages were similar (LSM 60.9, 60.9, 60.7 years SE 0.850; $P = 0.974$).

Mean HBS for these PHS categories was 1.9, 2.2, and 2.8 respectively and differences were statistically significant ($P < 0.001$) (Table 4). Post hoc analysis showed that the HBS for those in the "very good" PHS group was significantly better than for the two lower PHS categories. Adjustment for age, BMI and sex did not modify this finding.

Compared with one year ago, most participants reported no change ($n = 154$) in PHS, with only 32 reporting an improvement and 17 reporting worsening of their PHS. The HBS for these three categories of change were not significantly different ($P = 0.235$) and were 2.42, 2.41, and 2.00, respectively.

3.7. Retirement status

Subgroup comparisons based on self-reported retirement status showed no significant differences in BMI, MDPS, or HBS. However, after adjusting for age, BMI, and sex, retirees reported significantly fewer PBHE than non-retired individuals (LSM ± SE 3.1 ± 0.264 and 4.3 ± 0.267 ($P = 0.006$) respectively). Chi-square test showed that retirees were also more likely to self-rate their physical activity as moderate-to-high ($P = 0.04$).

4. Discussion

This e-survey in adults of peri-retirement age showed an inverse association between adherence to the Mediterranean diet (MDPS) and the number of perceived barriers to healthy eating (PBHE). Cluster-analysis allowed us to identify three groups of participants based on reports of PBHE who differed significantly in terms of BMI, dietary habits (assessed as MDPS) and perceived health status (PHS). In addition, we found a positive association between the number of health behaviours exhibited by participants and self-reported PHS.

Table 4
Health behaviour score (HBS) by perceived health status (PHS) category.

	Perceived current health status				
	Least squares means			*SE*	*P*
	Bad/fair (n = 26)	Good (n = 102)	Very good (n = 78)		
HBS non adjusted	1.88	2.17	2.83	*0.177*	*<0.001*
HBS adjusted (age)	1.89	2.17	2.84	*0.174*	*<0.001*
HBS adjusted (age, BMI)	2.19	2.21	2.67	*0.155*	*<0.001*
HBS adjusted (age, BMI, sex)	2.22	2.22	2.66	*0.153*	*0.001*
Perceived health status compared with 1 year ago					
	Worse (n = 17)	No change (n = 154)	Better (n = 32)		
HBS unadjusted	2.00	2.42	2.41	0.235	0.235

Given the strong evidence supporting its efficacy and effectiveness in enhancing health, the MD is the dietary pattern of choice when promoting a healthy diet [14–16,25]. The PREDIMED study show that closer adherence to a MD, e.g. a MDPS of 9 or higher, was associated with significantly lower odds ratios for prevalence of obesity and risk of cardiovascular diseases [15,26]. Importantly, current evidence shows that small changes such as two-point increase in MDPS are strongly associated with lower health risks [14,15]. Results from the present study were in line with these findings; individuals scoring ≥9 in MDPS were significantly leaner than those scoring ≤8. MD adherence in the current study was lower than that of Mediterranean populations as reported in the PREDIMED study (mean MDPS of 8.7 ± 2 at baseline) [15]. Even the MDPS for those classified in the upper tertile in the current study (7.9 ± 1.2) was below the mean values for the PREDIMED population, showing that even among those reporting relatively healthier eating patterns, there is significant room for improvement. Low numbers of participants in this study complied with the MD recommendations of health beneficial food or food groups such as nuts, fish, wine, fruit (men), and olive oil, as well as with recommendations to limit the consumption foods such as red meat and butter/margarine. These are food groups and recommendations commonly associated with significant health benefits [15,26] and therefore should be targeted in dietary interventions.

Several barriers can potentially limit adoption of healthier eating patterns. The pan-European consumer attitudinal survey identified "time" and "taste" as the most frequent PBHE among the EU population [21]; for UK-based respondents, "willpower" was the most frequent barrier [21]. A recent telephone-survey in Northern Ireland reported that 'lack of willpower' and 'willingness to change', were the most common PBHE [27]. A recent study offering a "healthy diet" for 3 days to a small group of Scottish middle-age adults, identified "time pressures", "desire for convenience" and "lack of motivation to cook" as important PBHE [28]. In the present study, three PBHE clusters emerged. Cluster-1 characterised by "busy lifestyle", "irregular working hours", and "the belief that healthy eating involves lengthy preparation", comprised the younger, more overweight individuals with the lowest MDPS and HBS. These "time pressure related" PBHE were therefore likely to impact other health behaviours (e.g. physical activity) and contribute to the greater prevalence of health risk factors (i.e. BMI) and its associated risks among participants in this cluster. Cluster-2 identified "lack of willpower" and "finding it hard to give-up liked foods" as characteristic PBHE and comprised older, but leaner participants with higher MDPS and fewer PBHE. In contrast, those in cluster-3 were characterised by no specific PBHE and reported the lowest number of PBHE and included older, and the leanest, individuals who scored the highest MDPS and HBS. Interestingly, our adjusted results showed that members of clusters-2 and -3 were significantly different from cluster-1 in terms of BMI, MDPS, and number of PBHE, but not HBS; only members of cluster-2 however scored lower in HBS than members of cluster-3. Our findings that "cost" and "lacking cooking skills" were not prominent PBHE among participants of this study may be explained by the relatively low cost of many foods in the MD eating pattern [29], the relative affluence of the participants (48% were educated to degree level or above; Table 1) and a cohort effect – these older people were from generations who were more likely to have been taught cooking at school and/or from a parent. Recent evidence from worksite studies in the USA suggest that workers' views on adopting healthier eating patterns focus on availability of a wider choice of healthful, convenient, more affordable food in cafeterias [30]. Based on these results and the characteristics of cluster-1 members in the current study, those in employment might benefit from the availability of healthier food in workplaces and from the development of a wider range of healthier, convenient food-products [31].

Compliance with more health behaviours including non-smoking, being physically active, moderate alcohol intake, and consumption of fruit and vegetables, is associated with up to four-fold lower mortality-risk, equivalent to 14 years in chronological age [2,3]. In the present study, our HBS was associated with better PHS among participants. Significant evidence indicates that self-rated health is an independent predictor of mortality [5,32,33]. Our results are in line with those from recent cross-sectional studies of Swedish adults indicating that modest increases in fruit and vegetables intake, or leisure-time physical activity by older adults (55–64 years) [34], as well as exercise and total physical activity in adults (25–64 years) [35], are strongly associated with self-rated health. In addition, a longitudinal study of Swedish adults found that health behaviours including smoking, exercise, social support and healthy eating were associated with self-rated health up to two decades later [6]. Self-rated health is associated with socioeconomic variables such as education and employment status [35] but socioeconomic status does not necessarily explain the relationship between health behaviours such as physical activity and self-rated health [35]. However economic factors may be important determinants of dietary choices in later life, particularly around retirement [36].

In the present study retirees did not differ in terms of BMI, MDPS, or HBS, but were more likely to report less PBHE and being physically active than non-retired participants. These results contrast with previous findings suggesting greater obesity risk associated with decreased consumption of fruits and vegetables particularly among retirees from manual occupations [37]. Increased body weight in mid-life predicts poorer physical and cognitive health in later life [38].

The results of this study have important implications for researchers interested in behaviour change and for policy makers. Our identification of natural groups of PBHE through cluster-analysis and their association with body mass, health behaviours and self-rated health suggests that pre-screening for PBHE cluster-membership may have utility in personalising lifestyle-based interventions. These findings may help in the development of screening tools in the form of standardised questionnaires useful in stratifying individuals.

Among the limitations of this study is the fact that self-reported information is susceptible to recall and other biases such as social desirability [39]. In addition, generalisation of the findings from this study is limited by the nature of the population sample surveyed which is likely to have included health-motivated individuals, as reflected by the low rates of smoking and mean BMI in comparison with general populations of retirement age [40]. These characteristics might have influenced our findings on the clustering of PBHE as well as presence or absence of other health-related behaviours. Confirmation of these findings using a larger population sample is warranted.

In conclusion, this e-survey was well received and proved to be a fast and efficient way to screen dietary habits, perceived barriers to healthy eating, and perceptions of health status among UK older people. Our study showed that individuals reporting more PBHE are likely to have lower MDPS, and higher BMI and HBS. Current self-perceived health was significantly and positively associated with the number of health behaviours. Although we cannot exclude confounding from different sources of bias (e.g. optimistic bias), our results are consistent with evidence indicating these readily-assessed behavioural factors are associated with perceived, and objectively measured, health. These findings may help in developing dietary interventions promoting the MD among individuals of peri-retirement age.

Contributors

Jose Lara and John C. Mathers conceived and designed the study and developed the study objectives. Leigh-Ann McCrum was responsible for acquisition of data and quality assurance. Jose Lara wrote the first manuscript. All authors contributed to the interpretation of data, writing and approved the final manuscript.

Competing interests

The authors declare no conflict of interest.

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Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at http://dx.doi.org/10.1016/j.maturitas.2014.07.003.

References

[1] US Burden of Disease Collaborators. The state of us health, 1990-2010: burden of diseases, injuries, and risk factors. J Am Med Assoc 2013;310:591–606.
[2] Khaw KT, Wareham N, Bingham S, Welch A, Luben R, Day N. Combined impact of health behaviours and mortality in men and women: the EPIC-Norfolk prospective population study. PLoS Med 2008;5:e12.
[3] van Dam RM, Li T, Spiegelman D, Franco OH, Hu FB. Combined impact of lifestyle factors on mortality: prospective cohort study in US women. Br Med J 2008;337:a1440.
[4] Murray CJL, Richards MA, Newton JN, Fenton KA, Anderson HR, Atkinson C, et al. UK health performance: findings of the Global Burden of Disease Study 2010. Lancet 2013;381:997–1020.
[5] Idler EL, Benyamini Y. Self-rated health and mortality: a review of twenty-seven community studies. J Health Soc Behav 1997;38:21–37.
[6] Mood C. Life-style and self-rated global health in Sweden: a prospective analysis spanning three decades. Prev Med 2013;57:802–6.
[7] Mathers JC. Nutrition and ageing: knowledge, gaps and research priorities. Proc Nutr Soc 2013;72:246–50.
[8] Kiefte-de Jong JC, Mathers JC, Franco OH. Nutrition and healthy ageing: the key ingredients. Proc Nutr Soc 2014;73:249–59.
[9] Schäfer M, Jaeger-Erben M, Bamberg S. Life events as windows of opportunity for changing towards sustainable consumption patterns? J Consum Policy 2012;35:65–84.
[10] Wilson DM, Palha P. A systematic review of published research articles on health promotion at retirement. J Nurs Scholarsh: Off Publ Sigma Theta Tau Int Honor Soc Nurs/Sigma Theta Tau 2007;39:330–7.
[11] Sofi F, Cesari F, Abbate R, Gensini GF, Casini A. Adherence to Mediterranean diet and health status: meta-analysis. Br Med J 2008;337:a1344.
[12] Sofi F, Abbate R, Gensini GF, Casini A. Accruing evidence on benefits of adherence to the Mediterranean diet on health: an updated systematic review and meta-analysis. Am J Clin Nutr 2010;92:1189–96.
[13] Sofi F, Macchi C, Abbate R, Gensini GF, Casini A. Mediterranean diet and health status: an updated meta-analysis and a proposal for a literature-based adherence score. Public Health Nutr 2013:1–14.
[14] Salas-Salvado J, Bullo M, Babio N, Martinez-Gonzalez MA, Ibarrola-Jurado N, Basora J, et al. Reduction in the incidence of type 2 diabetes with the Mediterranean diet: results of the PREDIMED-Reus nutrition intervention randomized trial. Diabetes Care 2011;34:14–9.
[15] Estruch R, Ros E, Salas-Salvado J, Covas MI, Corella D, Aros F, et al. Primary prevention of cardiovascular disease with a Mediterranean diet. N Engl J Med 2013;368:1279–90.
[16] de Lorgeril M, Salen P, Martin JL, Monjaud I, Delaye J, Mamelle N. Mediterranean diet, traditional risk factors, and the rate of cardiovascular complications after myocardial infarction: final report of the Lyon Diet Heart Study. Circulation 1999;99:779–85.
[17] Papadaki A, Scott JA. The Mediterranean eating in Scotland experience project: evaluation of an Internet-based intervention promoting the Mediterranean diet. Br J Nutr 2005;94:290–8.
[18] Goulet J, Lapointe A, Lamarche B, Lemieux S. Effect of a nutritional intervention promoting the Mediterranean food pattern on anthropometric profile in healthy women from the Quebec city metropolitan area. Eur J Clin Nutr 2007;61:1293–300.
[19] Logan KJ, Woodside JV, Young IS, McKinley MC, Perkins-Porras L, McKeown PP. Adoption and maintenance of a Mediterranean diet in patients with coronary heart disease from a Northern European population: a pilot randomised trial of different methods of delivering Mediterranean diet advice. J Hum Nutr Diet: Off J Br Diet Assoc 2010;23:30–7.
[20] Lara J, Hobbs N, Moynihan PJ, Meyer TD, Adamson AJ, Errington L, et al. Effectiveness of dietary interventions among adults of retirement age: a systematic review and meta-analysis of randomized controlled trials. BMC Med 2014;12:60.
[21] Kearney JM, McElhone S. Perceived barriers in trying to eat healthier—results of a pan-EU consumer attitudinal survey. Br J Nutr 1999;81(Suppl 2):S133–7.
[22] Hughes G, Bennett KM, Hetherington MM. Old and alone: barriers to healthy eating in older men living on their own. Appetite 2004;43:269–76.
[23] Erik von E, Douglas GA, Matthias E, Stuart JP, Peter CG, Jan PV. Strengthening the reporting of observational studies in epidemiology (STROBE) statement: guidelines for reporting observational studies. Br Med J 2007;335:806–8.
[24] Schröder H, Fitó M, Estruch R, Martínez-González MA, Corella D, Salas-Salvadó J, et al. A short screener is valid for assessing Mediterranean diet adherence among older Spanish men and women. J Nutr 2011;141:1140–5.
[25] Ruiz-Canela M, Estruch R, Corella D, Salas-Salvadó J, Martínez-González MA. Association of mediterranean diet with peripheral artery disease: the predimed randomized trial. J Am Med Assoc 2014;311:415–7.
[26] Martínez-González MA, García-Arellano A, Toledo E, Salas-Salvadó J, Buil-Cosiales P, Corella D, et al. A 14-item Mediterranean diet assessment tool and obesity indexes among high-risk subjects: the PREDIMED trial. PloS ONE 2012;7:e43134.
[27] Appleton KM, McGill R, Neville C, Woodside JV. Barriers to increasing fruit and vegetable intakes in the older population of Northern Ireland: low levels of liking and low awareness of current recommendations. Public Health Nutr 2010;13:514–21.
[28] Macdiarmid JI, Loe J, Kyle J, McNeill G. It was an education in portion size. Experience of eating a healthy diet and barriers to long term dietary change. Appetite 2013;71:411–9.
[29] Drewnowski A, Eichelsdoerfer P. The Mediterranean diet: does it have to cost more. Public Health Nutr 2009;12:1621–8.
[30] Devine CM, Nelson JA, Chin N, Dozier A, Fernandez ID. Pizza is cheaper than salad: assessing workers' views for an environmental food intervention. Obesity 2007;15:57S–68S.
[31] Combet E, Jarlot A, Aidoo KE, Lean MEJ. Development of a nutritionally balanced pizza as a functional meal designed to meet published dietary guidelines. Public Health Nutr 2013:1–10. FirstView.
[32] Giltay EJ, Vollaard AM, Kromhout D. Self-rated health and physician-rated health as independent predictors of mortality in elderly men. Age Ageing 2012;41:165–71.
[33] Benyamini Y. Why does self-rated health predict mortality? An update on current knowledge and a research agenda for psychologists. Psychol Health 2011;26:1407–13.
[34] Sodergren M, McNaughton SA, Salmon J, Ball K, Crawford DA. Associations between fruit and vegetable intake, leisure-time physical activity, sitting time and self-rated health among older adults: cross-sectional data from the WELL study. BMC Public Health 2012;12:551.
[35] Sodergren M, Sundquist J, Johansson SE, Sundquist K. Physical activity, exercise and self-rated health: a population-based study from Sweden. BMC Public Health 2008;8:352.
[36] Conklin AI, Maguire ER, Monsivais P. Economic determinants of diet in older adults: systematic review. J Epidemiol Community Health 2013;67:721–7.
[37] Nooyens AC, Visscher TL, Schuit AJ, van Rossum CT, Verschuren WM, van Mechelen W, et al. Effects of retirement on lifestyle in relation to changes in weight and waist circumference in Dutch men: a prospective study. Public Health Nutr 2005;8:1266–74.

[38] Sun Q, Townsend MK, Okereke OI, Franco OH, Hu FB, Grodstein F. Adiposity and weight change in mid-life in relation to healthy survival after age 70 in women: prospective cohort study. Br Med J 2009;339:b3796.
[39] Lara JJ, Scott JA, Lean MEJ. Intentional mis-reporting of food consumption and its relationship with body mass index and psychological scores in women. J Hum Nutr Diet 2004;17:209–18.
[40] Södergren M, Wang WC, Salmon J, Ball K, Crawford D, McNaughton SA. Predicting healthy lifestyle patterns among retirement age older adults in the WELL study: A latent class analysis of sex differences. Maturitas 2014;77:41–6.